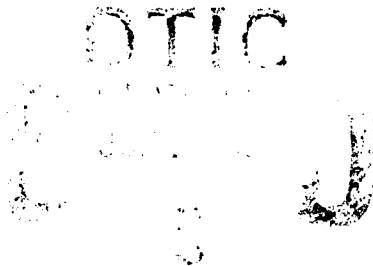


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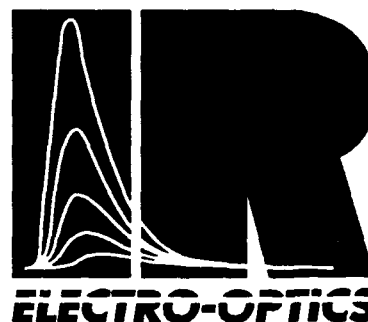


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Interim Report

INVESTIGATION OF TECHNIQUES FOR ACCREDITING SURROGATE TARGETS

For Period April–December 1990



A.J. LARocca
Infrared Information Analysis Center
A DTIC-Sponsored DoD Information Analysis Center

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Abstract

This Interim Report describes a major part of the effort in the first year of a two-year task known as an Investigation of Techniques for Accrediting Surrogate Targets. It discusses the makeup of the major product, which is a state-of-the-art report consisting of ten chapters focussed on the subject of accreditation. The Interim Report discusses in some detail the activities of the effort in achieving its goals, for the period from April 1990 to the end of the calendar year 1990.

Preface

The Infrared Information Analysis (IRIA) Center is a DTIC-administered Department of Defense Information Analysis Center operated by the Environmental Research Institute of Michigan (ERIM) under contract to the Defense Electronics Supply Center (DESC). Its mission is to collect, analyze, and disseminate to authorized recipients information concerning infrared and electro-optical research and development. To this end, the IRIA Center publishes and distributes the Infrared Newsletter, IRIA Data Compilations, the Proceedings of the Infrared Information Symposia (Proc. IRIS), the proceedings and/or minutes of the meeting of the seven Specialty Groups of IRIA, and IRIA State-of-the-Art Reports. The Center serves as national reference library in military infrared and E-O technology, offering assistance and advice to visitors having the appropriate clearance and need-to-know. Special bibliographies and searches are prepared for IRIA-IRIS subscribers upon request.

This Interim Report is written in partial fulfillment of requirements for deliverables on an IRIA subtask, Investigation of Techniques for Accrediting Surrogate Targets. It is intended to provide a summary of progress from the latter part of April, 1990 (at which time a letter interim report was sent to the contract monitor) to approximately the end of calendar '90.

The contract monitor is Mr. J. L. Thacker, AMCPM-ITTS-P, Aberdeen Proving Ground, MD. Others associated with the task by providing information and assistance are from Aberdeen Proving Ground, Mr. R. Brazzon, PM-ITTS, and Mr. F. Carlen, STECS-EN-PH.

Dr. J. MacCallum, OUSDA(R&AT/EST), is the Contracting Officer's TR for the IRIA contract, issued by the Defense Electronics Supply Center, Attn: DESC-PSC/S. Dilts.

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Introduction

This Interim Report provides a discussion of events associated with the IRIA task entitled "Investigation of Techniques for Accrediting Surrogate Targets" from April to December 1990, which is approximately the end of the first year of a two-year effort. This task is an IRIA Special Study sponsored by the Army, with objectives to investigate the utilization of the characteristics of sensors and targets (actual and simulated), and their interaction, for the development of surrogate accreditation criteria.

These objectives are being satisfied through three efforts, of which the primary one is the work leading to the publication of a document entitled State-of-the-Art Report on Factors in the Infrared Relevant to the Accreditation of Threat Simulators. A secondary effort is to model threat vehicles, or simulated threats, using the ERIM model, and to assist Aberdeen (CSTA) in the use of the model. The tertiary effort in this task is to provide material for the State-of-the-Art Report (SOAR) and technical assistance to the sponsor by maintaining contact with the technical community through visits, and through attendance at salient meetings in the quest for expert assistance and advice. The information required comprises essential knowledge regarding the three focal points of the SOAR, the weapon (sensor), the threat, and the threat simulator.

Discussion of Work to Accomplish

Using a time scale relative to publication of the SOAR, the following schedule is expected to satisfy the requirements of the contract. See accompanying chart.

Task 1: SOAR Publication

Schedule: 5 months for writing rough draft of Chapters 2-6; 4 months for writing final draft; 3 months to edit and publish.

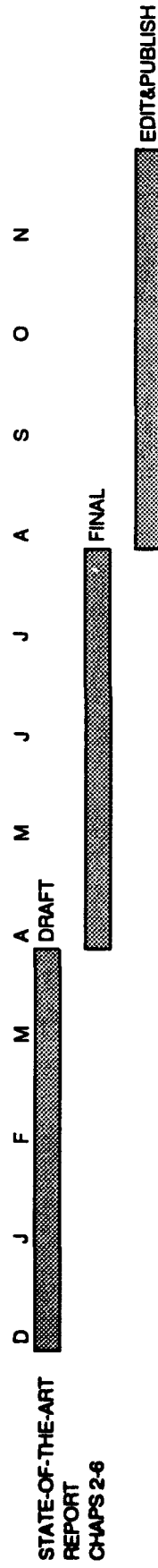
Five months, after initial draft of Chapters 2-6, for writing Chapter 1 and Chapters 7-10.

Task 2: Modeling

Schedule: 3 months to get together with Aberdeen personnel and determine which target will be modeled and establish parameters to be used in the model. Jayne Lyons is key to this effort.

SCHEDULE FOR PHASE 2 (1990-1991) OF THE PROGRAM

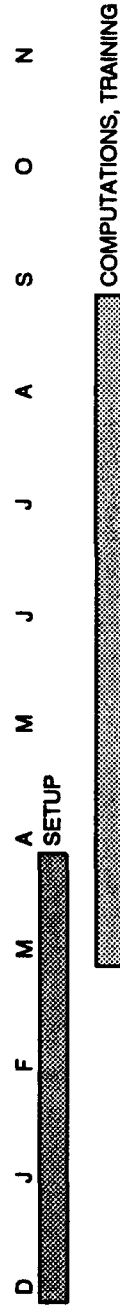
TASK 1



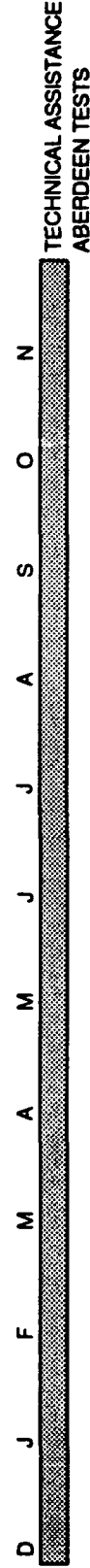
CHAP 1
CHAPS 7-10

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TASK 2



TASK 3



Six months to perform computations and validate model, and to train Aberdeen personnel in use of the model.

Task 3: Technical Assistance

Schedule: For whole contract period, give technical assistance to Aberdeen, maintain contact with the technical community, etc.

SOAR Outline

Presently, 10 chapters with tentative (essentially firm) titles as follows:

1. Introduction
2. Modeling
3. Sensor Systems Technology
4. The Weapon
5. The Target
6. The Surrogate (may be changed to The Threat Simulator)
7. Integration
8. The Specifications
9. The Choice(s)
10. Summary

The essential chapters are 2 through 6 on which the state-of-the-art focuses. The other chapters reflect the technology portrayed in these five chapters.

Chapter 2 on Modeling is to be authored by Bruce Morey of ERIM, and it will focus on the ERIM model which will be used to calculate the radiance of a model of a target that has been measured in the field. It is presumed that the ERIM model reflects the state-of-the-art in current-day computations of this sort.

Chapter 3 on Sensor System Technology should be fairly straightforward because it should be patterned after Dave Shumaker's FLIR Performance Handbook.¹ Dave Kryskowski of ERIM is slated to write this chapter. It is best to have this chapter integrated as a unit into the SOAR; but if expediency dictates, the chapter can be abbreviated to little more than a reference to the FLIR Handbook.

Chapter 4 on The Weapon needs less expertise than contact. Someone writing, or intimately involved in, that chapter has to be highly involved with smart weapons, and have access to the characteristics of all of those that would be used against ground

¹Shumaker, D. L., J. T. Wood, C. R. Thacker, FLIR Performance Handbook, DCS Corporation, Alexandria, VA. Copyright, 1988.

targets, which are the primary focus of this SOAR. It is proving rather difficult to find someone who can handle this chapter. Because of the involvement in getting this kind of information, it will probably be necessary to call upon the sponsor for help in acquiring the information.

The format for this chapter is fairly straightforward because it can be fashioned after the IRIA SOAR on Scanning Imagers.² However, it needs someone with direct access to the weapons. One possible source of assistance is the Smart Weapons Office at Redstone, if they are willing to help.

Chapter 5 on The Target will be authored by George Zissis of ERIM. IRIA and other sources can be used to access a variety of ground targets, especially tanks, which should be the focus on this chapter. Writing this chapter will involve gathering as much information as possible on various targets and analyzing the information so as to present essentially a generic target with a realistic determination of an expected range of spectral and spatial variations. The success of this chapter will depend on the intuition of the author based on years of involvement with target measurements. The experimental team at Aberdeen Proving Ground (CSTA) can be of invaluable assistance in procuring target information and validating generic models. The collection of target data, however, is sorely lacking in, especially, downlooking measurements on targets.

LaRocca will write Chapter 6 on The Surrogate. There exists an array of material to work from which describes a variety of surrogates made in different sizes and shapes in an assortment of configurations. This chapter will mainly focus on those that have been constructed in the past, without necessarily attempting to demonstrate their successes, unless these successes are well documented and credible. The format of this chapter is yet to be crystallized because there is tremendous possible variability in its appearance.

As editor of the entire SOAR LaRocca will relate different chapters to each other. There is good reason to emphasize the interplay between the chapter on the surrogate and the one on modeling, in which it should be shown how the model can be used to design surrogates, once it has been established what the surrogate is supposed to do.

There is as yet no real format for the other chapters because they will depend so much on the outcome of the so-called essential chapters. Note that the schedule calls for them to start after the rough drafts of the essential chapters are in. The

²Optical-Mechanical, Active/Passive Imaging Systems, IRIA State-of-the-Art Report, May 1982.

purpose of the chapter on Integration is just that, to pull together the information in the earlier chapters in an analysis that creates specifications in the construction of surrogates. In the chapter on The Specifications, it should be possible to indicate the utility of various surrogate constructions, and, by applying the factors delineated in the earlier report, i.e., "Report on a Task to Study the construction of Threat Surrogates" by LaRocca, et al, show how procedures can be produced to establish accreditation.

As far as the chapter on The Choice(s) is concerned, by the time the rest of the SOAR is written, it may cease to exist. When the SOAR was conceived as a Handbook there might have been reason to demonstrate choices; but as a SOAR it may be superfluous, unless the chapter can be used as a medium for embellishing on the Specifications. This chapter will definitely have to wait until the rest of the SOAR is written.

Prior Activities and Technical Status

Most of the activities projected in the previous activity report of 18 April 1990 have been started, not necessarily without problems. The meeting, for instance, between Frank Carlen and Jayne Lyons and LaRocca did not come off as soon as planned because of scheduling difficulties. This presented no serious problem because funding for the modeling activity has been held in reserve, and in fact, more funding was allotted to the current phase of the program for some modeling training for Aberdeen personnel.

As reported internally to the ERIM administration, the Carlen visit to ERIM kept slipping until the beginning of the second phase of the two-year task, which is just about now. More on this toward the end of this report. Recall that the Carlen visit was intended to set up a plan for providing experimental data on the test of a ground vehicle from which a model could be constructed using the ERIM computer simulation, resulting in a set of data for comparison with experiment.

Regarding the writing of the Handbook - which is now being called a State-of-the-Art Report (SOAR) - it had been agreed that no additional funding was needed for honoraria, because the number of authors from outside ERIM could be minimized. In fact, as becomes evident later in this report, the natural inclination to avoid outsiders seems to be justified. Agreements have been signed with various persons, accepted by the sponsor. At least one of these agreements will probably have to be voided because of lack of compliance.

In the meantime, a proposal was sent to the sponsor during the July time frame for continuation of work on the Handbook (actually SOAR). The sponsor responded promptly, and the task has been able to continue smoothly without any interruption of work. LaRocca prepared slides for the technical monitor in a presentation of the effort that was being expended at ERIM. A similar set of slides was prepared for presentation by Mr. Millway at a tripartite committee meeting in England.

During this period LaRocca attended a conference on Smart Munitions Technology, a very worthwhile event which helped put things in perspective with respect to the choice of material for the SOAR. In fact, at that time, a potential author was found for the difficult task of writing the chapter on Smart Munitions (i.e., The Weapon). Also during this period LaRocca started preparing a paper for presentation in November at a Workshop on Target Simulator Development held at the Georgia Tech Research Institute. Additionally during this period it started to become obvious that the two-color radiometer at CSTA would not be fielded soon, certainly not before the winter season made measurements

questionable. The modeling effort, therefore, had to be put on hold.

By this time, the October time frame, preparation for writing the SOAR had been proceeding according to plan with authors for the different chapters identified and supplied with the material they needed to start up a rough draft. LaRocca started assembling material for use in the chapter on The Target and also started looking into the use of the PRISM software for help in the analysis of target data. The CSTA experiment was further delayed.

As part of the technical effort in this task, maintaining contact with those special communities that can provide SOAR input, LaRocca attended a conference on Automatic Target Recognition Technology for Tomorrow, held at the NSWC. And later in the month of November, LaRocca presented a paper at the workshop mentioned above. A set of the slides used for the presentation were provided for the proceedings of the workshop; and a set of the same slides was sent to the technical monitor. The purpose of the paper was to focus on the ERIM effort, emphasizing the production of the SOAR. The title of the paper was Handbook for Surrogate Accreditation. Some objections were raised with respect to using the term "Handbook" and the author concurred. The term was thus changed to State-of-the-Art Report (SOAR). As a result of concurrence from the technical monitor the title of the publication will be changed to State-of-the-Art Report on Factors in the Infrared Relevant to the Accreditation of Threat Simulators. This is an imposing title, but should be politically quite acceptable.

Also during this period LaRocca attended a meeting in Huntsville, AL on Detection, Discrimination, Classification of Targets in Clutter. Some important contacts have been made regarding support for the writing of the chapter on the weapon system. It appeared by this time that the person with whom the agreement had been made for writing this chapter was unwilling or unable, because of other commitments, to satisfy the agreement made earlier. It should be recognized by all involved in this effort that the chapter on the weapon system is probably the most difficult to pursue, mostly because of the content, and perhaps the most important. In some cases it is impossible, or next to impossible to obtain information because it is jealously protected under the cover of security or proprietary considerations. Without the help of the sponsor, the information is generally withheld.

In particular, with regard to sponsor involvement, there is undoubtedly a wealth of information that can be derived from the Smart Weapons Management Office at Redstone Arsenal, AL, if the sponsor can set up a pipeline between ERIM and that office. In fact, LaRocca has spoken to persons from that office with regard to help in writing the chapter on the weapon system, but nothing has come from the contact so far. With sponsor involvement there is still reason for hope.

As of the end of calendar year 1990 no chapter drafts have been received except from Bruce Morey who is writing the very important chapter on Modeling. With the beginning of the second year of the task and no experimental data, it was decided that LaRocca would visit Carlen and negotiate for data from the test of the Hybrid 2S3 which was thoroughly analyzed and reported on, and which would represent an excellent case for comparison with model results. Carlen is to supply all of the auxiliary data along with the experimental results. Bob Brazzon is to supply the drawings for the structure which covered the M48 used in the test. One of the major difficulties in using this type of target is that there are no standardized descriptions of its construction as there would be for a conventional vehicle.

The modeling of the Hybrid vehicle will represent a major activity in the second year of the task, along with the writing of the SOAR. In addition to this, a serious investigation will be made of the properties of materials that can be used in the construction of threats and threat simulators. There will also be a continuing effort to maintain contact with the technical community and seek information to assure the success in establishing procedures for accreditation as defined in depth in the State-of-the-Art Report.